

# Review of the Effectiveness of Digital Game-Based Learning in Education

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**Abstract**—Digital Game-Based Learning (DGBL) has attracted the interest of various parties to use games as a learning tool. Continuous research conducted every decade followed by technological developments has led to various books and research articles that have increasingly popularized the existence of DGBL as an alternative in learning. The existence of students who are increasingly adapting to technology has supported the existence of DGBL as an alternative during learning, especially in online learning. The trend of using digital game-based learning gave rise to the idea that DGBL has effectiveness in providing meaningful learning experiences for students. DGBL can also be combined with other learning methods, strategies, or models to increase its effectiveness during learning.

**Keywords**—digital game-based learning, effectiveness, game-based learning, education

## I. INTRODUCTION

One of the learning problems that always arise during learning is student boredom. This often occurs because the character of students is eroded because they cannot meet directly with students. Anxiety of a teacher must be reduced through creating creativity by developing learning methods and media. Teachers regardless of their characteristics, both demographically and regionally, must be able to use technology to develop learning strategies. So creativity and technology are decisive. Optimizing the use of technology is an option during online learning activities [1].

Along with technological developments, teacher must be able to quickly adapt and be able to use technology for learning development, especially during

a pandemic like today [2]–[4]. Online technology allows us to still interact with students, either in one direction, or in two directions [1]. There are various applications that we can use, for example Learning Management System (LMS), such as Google Classroom, Edmodo, Moodle, WhatsApp, video conference using Google Meet or Zoom, “*Rumah Belajar Kemdikbud*”, YouTube, and many more. In delivering learning materials, teachers must be creative so that students do not feel bored while carrying out learning at home. Variations in the use of learning media that are adapted to students' conditions are needed to be able to keep students learning well [5], [6]. Giving an interlude in the form of games in the middle of learning can also be a solution to keep the learning atmosphere fun.

Generation Z is a generation that is already familiar with gadgets and games. Children generally like games, so the use of game based learning is suitable to be applied to the conditions of the digital generation as it is today [7], [8]. Game based learning is a learning method that uses games or game applications that have been specifically designed to assist in the learning process [9]. By using game-based learning we can provide stimulus to three important parts of learning, namely emotional, intellectual and psychomotor. Teacher(s) don't need to be afraid if they don't have a background as a game developer or are less technology literate if they want to implement game-based learning. There are many educational games that can be found on smartphone devices, even many are web-based applications.

The only things that teacher should do is they need to choose a game that is adapted to the material that we

will provide. They also don't need to worry that students can't use the games that will be used, because generally there are instructions in every game, whether it's on a smartphone or a web-based application. During online learning activities, teacher could insert games in every meeting as evaluation material. There are several types of games that have been used in remote learning, including Quizizz, Kahoot, Nearpod, and Wordwall [7], [9]. Each game has certain characteristics, although some are almost similar.

Game in learning is something that is interesting and fun. With learning that is packaged with games, students will feel interested and learning becomes fun so that it is expected that students' memory of the material presented is also quite high. Thus, the explanation of learning content during remote learning can still attract students' interest in learning. The evaluation of learning in the form of a quiz of choice has no doubt that students need to be treated with interesting learning models so that they will not experience boredom in learning [9]–[11]. This creation is indeed still depending in the learning case(s) but can be cloned in other schools to ensure its effectiveness.

Educators really have to be able to innovate and be creative in learning so that students remain enthusiastic about learning and can easily understand the material we provide [12], [13]. The philosophy of learning is to transfer material, character and inspire. The thing that is no less important is to make the learning atmosphere fun and make a deep impression so that the material is always imprinted in the minds of students. Creating a learning environment that is always fun is closely related to creativity and this is where technology plays a big role. So a learner must combine three key words; learning philosophy, insight, creativity and technology.

Game-based learning can also be optimized during online learning. Several game applications that have been developed so far have given rise to new terms in game-based learning [8], [10], [14], [15]. Digital game-based learning is a form of game development in learning that utilizes applications or websites that can be accessed during online learning. This development is directed to support learning activities that remain interesting for students while studying at home.

## II. DIGITAL GAME-BASED LEARNING

### A. *Digital Game-Based Learning (DGBL)*

DGBL has attracted the interest of various parties in using games as a learning tool. Continuous research that has been carried out in every decade has led to various books as well as research articles that have increasingly popularized the existence of DGBL as an alternative in learning [16]. This is inseparable from the development of technology and students who are increasingly adapting to technology. The era of the industrial revolution 5.0 led to the development of an increasingly massive and unstoppable digital world. There are many flows of information, the emergence of a variety of

interesting digital applications and content, to the emergence of a digital generation that is accustomed to interacting through cyberspace, and cannot even be separated from all the interesting things in it [17], [18]. This generational character supports the existence of DGBL as a tool that is easier to use in learning.

Differences of opinion often arise regarding the perception that games are always something that is relaxed, not serious in nature, and different from learning, it seems that it can slowly be eliminated. Today, the majority of people believe that games are interesting, and when used effectively, games can play a role in learning [8], [10]. The question that arises then is why DGBL is interesting and effective, and how games can be integrated into the learning process to maximize students' learning potential.

Educational games are often designed by academics so that they have a less attractive impression in game design. But making games fun to play, but not having a role in learning is also not what we expect. Ultimately, DGBL creates space for collaboration between pedagogy and game design to maximize their function in learning [16].

### B. *Digital Game-Based Learning Effectiveness*

Several previous studies have found that games improve learning and make learning more effective [10]. The results of this study even contain games on various learning content in schools. Games are seen as effective in learning according to learning outcomes and changes in student behavior after they learn with the help of games [19].

Games have been proven to teach low-level intellectual skills and to improve motor skills. DGBL is also able to realize established learning principles and models. Games are effective in supporting learning because they take place in a meaningful context [19]. Games in learning are also associated with the learning environment and can demonstrate students' skills in their learning situations. Learning that occurs in a meaningful context is what causes games to have a positive influence on learning [10].

Based on the trend of using digital game-based learning, it is known that DGBL has effectiveness in providing meaningful learning experiences for students [10]. In addition, digital game-based learning is also able to increase student interaction with teachers during learning. In addition, DGBL can also trigger students' cognitive development, as well as develop digital literacy in students [20]. Students' skills in games are also believed to be able to foster students' social-emotional abilities and soft skills. Other skills developed through games include problem solving, communication, collaboration, and critical thinking skills [18], [19]. This is in line with the skills that students need to master in learning in the 21st century. No less important than DGBL is a learning process that is completely student-centred, as well as training

students' independence in learning. Digital game-based learning can be combined with other learning methods, strategies or models to increase its effectiveness during learning.

### III. APPROACH ON DIGITAL GAME-BASED LEARNING DEVELOPMENT

The application of DGBL is carried out by adopting three approaches, namely involving students in making educational games, educators developing educational games to teach students, and integrating ready-to-use Commercial Off-The-Shelf (COTS) games into learning [16]. The first approach, students can design the game they want independently. Students can develop games, and study the related content in this game at the same time. This approach cannot guarantee the production of quality games. It requires a fairly long process and it is necessary to pay attention to the limitations of students' skills in game design. This causes this approach cannot be developed in all learning environments.

The second approach, educators design games to be implemented in learning. This approach is commonly referred to as the "Holy Grail" approach. This approach is able to balance the needs of learning with entertainment in learning or "edutainment". The DGBL approach designed by this educator is professionally developed. In this case, the games made also take into account aspects of content, learning skills, and the quality of the games produced, so as not to lose to compete with games that have existed before [18].

The third approach is to integrate commercial digital game-based learning. This approach invites to implement existing commercial games, which were not initially even developed as learning games, and to use these games in the classroom. Games are used to support learning as a medium of learning, and/or evaluation of learning [19]. This approach is the most cost-effective approach because it was not developed in-house and the games used have also been tested for quality, both in terms of content and game design. This approach is considered the most effective to be applied in classroom learning.

The integration of COTS games has drawbacks such as inaccurate and incomplete topics or content because COTS games are not designed specifically for learning. Based on these weaknesses, there are several ways that can be done to minimize these weaknesses.

#### A. Choose a Game that Fits the Curriculum

The use of educational games in a lesson can be used as a pre-instructional strategy (for advanced administrators), a co-instructional strategy (for examples and practice learning in the domain), or a post-teaching strategy (for assessment and synthesis) [19], [20]. The selection of educational games must be balanced between curriculum needs and the structure of

the game itself, so that learning outcomes can be achieved properly.

#### B. Analyze Game Content

Educators recognize this as the biggest limitation of COTS games on DGBL. Any game designed to be engaging will tend to prioritize that aspect over accuracy and completeness of the content. If a game has no content or has inaccurate content then it cannot be used responsibly for DGBL. Strategies that can be done by educators to create cognitive imbalances (through instructional strategies and activities) by presenting or designing activities in which students find information that contradicts students' games and knowledge [22], [23].

#### C. Designing and Evaluating Games

After selecting a game, and analyzing its content, educators must decide what to do about unrepresented and inaccurate content. Evaluating educational games is not only the responsibility of the teacher, but also the responsibility of the students [21]. The more students who can evaluate the game, the easier it is for decision making to choose the game used in learning. Involving students in conducting evaluations needs to be done to meet curricular goals and to integrate games into the learning process. Activities they can do in evaluating games used in learning are by conducting game feasibility tests, assessing the truth of game information or providing comments on the games used.

#### D. Game Implementation

In the end, after analyzing and evaluating. Games that are suitable for learning can be implemented in learning needs, while games that are not in accordance with learning needs do not need to be used in learning. This evaluation pattern will be carried out on an ongoing basis to be able to find game patterns and structures that suit the needs of students. Game development in learning, of course, needs to be accompanied by the developer's ability to adapt to technological developments, student needs, and the attractiveness of game design that can be seen from the games that develop in the COTS game area.

### IV. CONCLUSION

DGBL has attracted the interest of various parties to use games as a learning tool. Continuous research conducted every decade; technological development; Students who are increasingly adapting to technology have produced various books and research articles that have increasingly popularized the existence of DGBL as an alternative in learning. Differences of opinion often arise regarding the perception that games are always something relaxing, not serious, and different from learning. This perception can be dispelled by the fact that today most people believe that games are interesting, and when used effectively, games can play a role in learning. Based on the trend of using digital game-based learning, it is known that DGBL has

effectiveness in providing meaningful learning experiences for students. Digital game-based learning can be combined with other learning methods, strategies, or models to increase its effectiveness during learning.

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